TMDL Development for the Floyds Fork Watershed

Draft Watershed Hydrology and Water Quality Calibration and Draft Water Quality Model

Louisville, KY
February 21, 2012

EPA United States Environmental Protection Agency

Region 4 serving the southeast

Presenters

- Tim Wool — National TMDL Expert
  Water Quality Modeler, TOM
- Brian Watson — Director, Water Resources Group
  Tetra Tech, Atlanta

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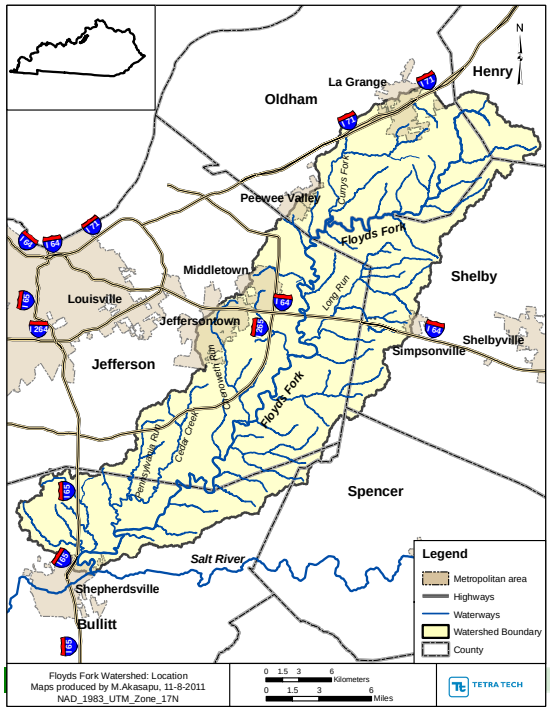

Summary of Data Sources

- KDOW
  - Lat/Longs for 73 NPDES Facilities and 11 Water Withdrawals
  - Lat/Longs for 49 Water Quality sites (26 USGS, 11 Currys Fork WBP, 7 MSD, 3 Bullitt WBP, 2 KDOW)
  - Water Withdrawal Information (Lat/Longs and pumping data)
  - KDOW Management Decisions Document. This document contained key information about expectations of the TMDL effort.
  - MS4 Information
  - Lat/Longs for 33 Assessment Points in watershed
  - Preliminary information on Water Quality Targets for Floyds Fork watershed
- USGS
  - Flow Data for Period of Record at 7 Stations
  - Water Quality Chemistry Data for 2007 and 2008 for 26 stations.

Summary of Data Sources

- MSD
  - Information for Weather Stations (TR and RG Stations).
  - Water Quality Chemistry Data. This includes data for 5 stations for the period of record.
  - Sonde data at 5 Locations
  - Floyds Fork Action Plan Update
  - Septic Tank Shapefile for Floyds Fork Watershed.
  - Links to key Water Quality Synthesis Reports and other online documents
  - SSO Information and data
  - 11 GIS Coverages including contours, Dfirms, etc.

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Hydrology Calibration

- Calibration period
  - January 1, 2001 through December 31, 2010
- 7 USGS Stations
  - 3 Main Stem
  - 4 Tributaries
- Quantitative Calibration
  - Miscellaneous Plots
  - Summarized by Statistics
- Qualitative Calibration
  - Analyzed Statistics
  - Developed Qualitative Calibration

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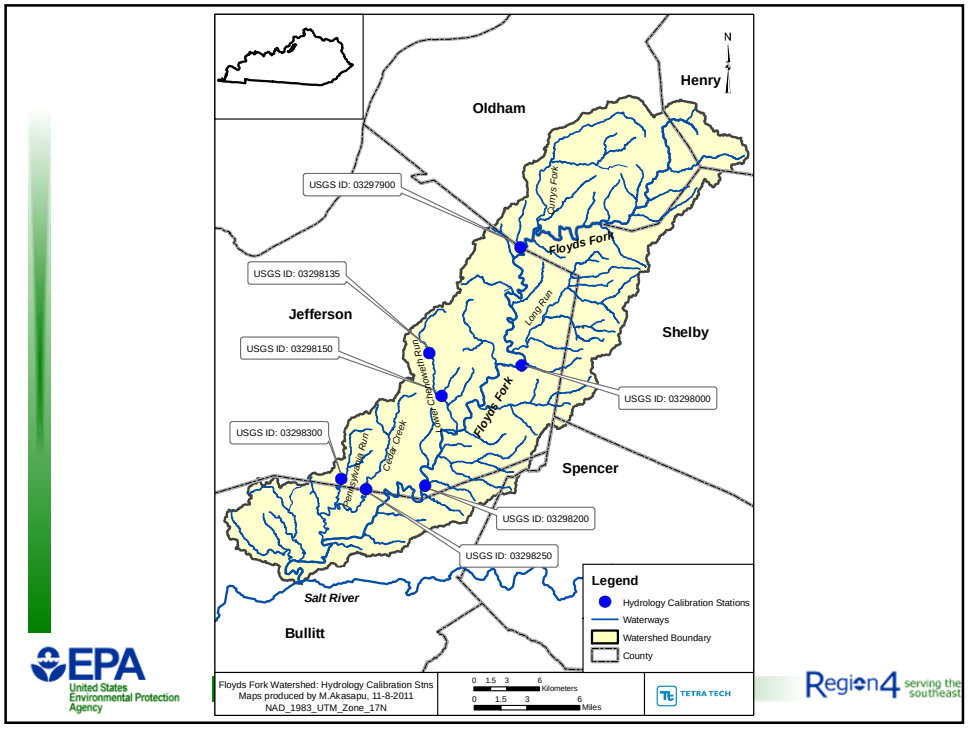

Hydrology Calibration – Qualitative

- Weight Each Statistic
  - 1 (Low) – 4 (High)
- Develop Statistical Range
  - 1 (Poor) – 4 (Very Good)
- Multiply Weight and Statistical Range Score
- Sum up Values
  - 80 is the Highest Score
  - 20 is the Lowest Score

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Hydrology Calibration – Qualitative

- Very Good = 80-75
- Good = 74-55
- Fair = 54-35
- Poor = 35-20

Location: Main Stem- Floyds Fork			
USGS Station ID	Station name	Qualitative Score	Quantitative Score
03297900	Floyds Fork near Peewee Valley	VG	77
03298000	Floyds Fork at Fisherville	VG	77
03298200	Floyds Fork near Mt. Washington	VG	80
Location: Tributaries			
03298135	Chenoweth Run at Ruckriegal Parkway	G	67
03298150	Chenoweth Run at Gelhaus Lane	VG	80
03298250	Cedar Creek at Thixton Road	G	67
03298300	Pennsylvania Run at Mt. Washington	VG	76

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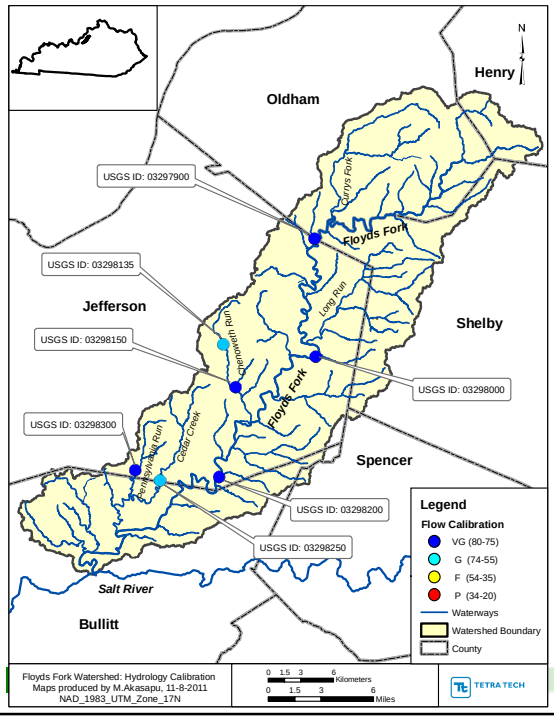

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Water Quality Calibration

- Calibration period
  - January 1, 2001 through December 31, 2010
- 26 USGS Stations
  - Primary period of data – 2007 and 2008
  - 8 Main Stem
  - 18 Tributaries
- 5 MSD
  - 3 Main Stem
  - 2 Tributaries (Lower Chenoweth Run)
- Quantitative Calibration
- Qualitative Calibration
- Focused on TN and TP

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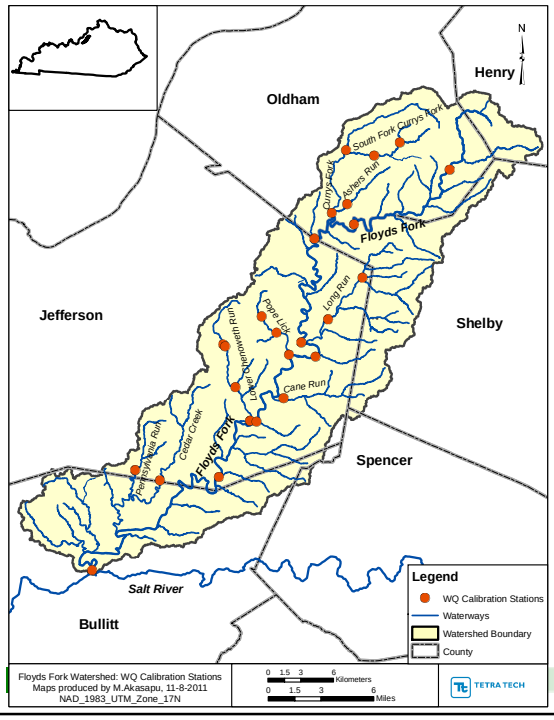

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Water Quality Calibration – Qualitative

- Based on Annual Average Difference of Simulated and Measured Loads
- Range of Percent Difference
  - Very Good = -40 – 40%
  - Good = -90 – 90%
  - Fair = -150 – 150%
  - Poor = -225 – 225%

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USGS WQ Stations - Location: Main Stem- Floyds Fork					
USGS Station ID	Station name	Qualitative Score		Quantitative Score	
		TN	TP	TN	TP
03297830	Floyds Fork at Highway 53	VG	VG	38	2
03297845	Floyds Fork near Crestwood	G	G	49	56
03297900	Floyds Fork near Peewee Valley	G	G	43	53
03297930	Floyds Fork at Echo trail bridge	G	G	67	63
03298000	Floyds Fork at Fisherville	G	VG	46	13
03298120	Floyds Fork at Seatonville Road	G	VG	47	35
03298200	Floyds Fork near Mt. Washington	G	G	54	42
03298470	Floyds Fork near Shepherdsville	G	VG	60	4
USGS WQ Stations - Location: Tributaries					
03297850	South Fork Curry's Fork at Moody Lane	VG	G	37	61
03297855	South Fork Curry's Fork at Highway 393	VG	G	27	81
03297860	North Fork Curry's Fork at Stone Ridge road	G	G	50	71
03297875	Ashers Run at Abbott lane near Crestwood	G	G	45	44
03297880	Currys Fork near Crestwood	VG	VG	17	20
03297950	Long Run at Old stage coach road	VG	VG	8	20
03297975	South Long Run at Hobbs Lane	VG	G	16	58
03297980	Long Run near Fisherville	VG	G	21	41
03298005	Pope lick at South poope lick road near Fisherville	VG	G	6	51
03298020	Chenoweth Run at Gelhaus Lane	VG	VG	20	35
03298100	Pope lick at pope lick road near	G	VG	60	19
03298110	Pope lick at Rehl road near Fisherville	VG	VG	23	32
03298135	Chenoweth Run at Ruckriegal	G	VG	59	25
03298138	Chenoweth Run at Jeffersontown STP	G	G	67	55
03298150	Chenoweth Run at Gelhaus Lane near	G	VG	65	30
03298160	Chenoweth Run at Seatonville road near Jeffersontown	G	VG	45	25
03298250	Cedar Creek at Thixton Road	VG	VG	23	8
03298300	Pennsylvania Run at Mt. Washington	G	G	47	43

MSD WQ Stations - Location: Main Stem- Floyds Fork					
USGS Station ID	Station name	Qualitative Score		Quantitative Score	
		TN	TP	TN	TP
EFFFF001	Floyds Fork at Ash Avenue	VG	VG	16	10
EFFFF003	Floyds Fork at Old Taylorsville Road	VG	VG	39	22
EFFFF002	Floyds Fork at Bardstown Road	G	VG	45	30
MSD WQ Stations - Location: Tributaries					
EFFCR001	Chenoweth Run # 1 at Gelhaus Lane	G	VG	52	27
EFFCR002	Chenoweth Run # 1 at Rickriegal Parkway	VG	G	2	85

Summary

- USGS Stations
  - TN = 11 Very Good, 15 Good
  - TP = 13 Very Good, 13 Good
- MSD Stations
  - TN = 3 Very Good, 2 Good
  - TP = 4 Very Good, 1 Good

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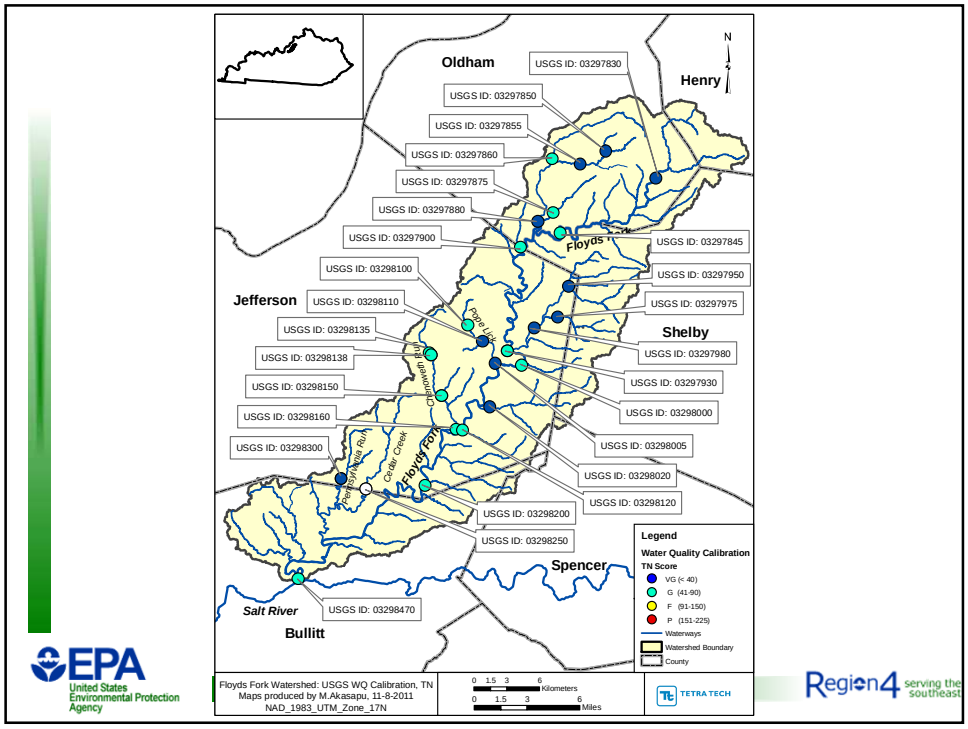
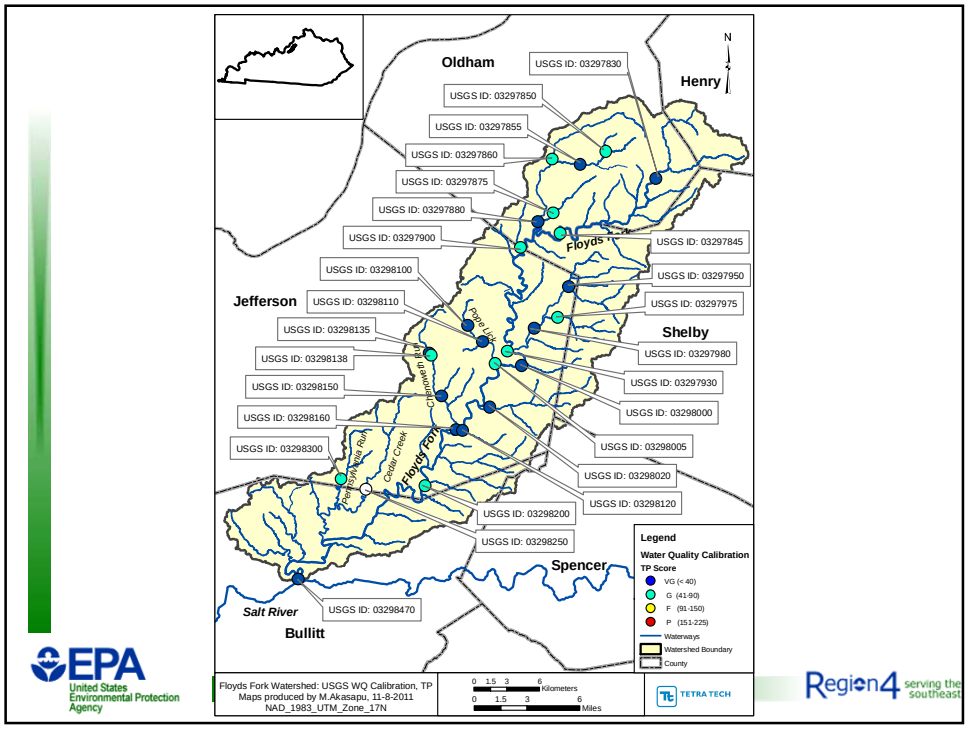

Oldham
Henry
Jefferson
Shelby
Spencer
Bullitt
Salt River
Floyds Fork
Cedar Creek
Pennsylvania Run
Chenoweth Run
Harrods Creek
USGS ID: 03297830
USGS ID: 03297850
USGS ID: 03297855
USGS ID: 03297860
USGS ID: 03297875
USGS ID: 03297880
USGS ID: 03297900
USGS ID: 03298100
USGS ID: 03298110
USGS ID: 03298135
USGS ID: 03298138
USGS ID: 03298150
USGS ID: 03298160
USGS ID: 03298300
USGS ID: 03298470
USGS ID: 03297845
USGS ID: 03297950
USGS ID: 03297975
USGS ID: 03297980
USGS ID: 03297930
USGS ID: 03298000
USGS ID: 03298005
USGS ID: 03298020
USGS ID: 03298120
USGS ID: 03298200
USGS ID: 03298250
N
Legend
Water Quality Calibration
TN Score
VG (< 40)
G (41-90)
F (91-150)
P (151-225)
Waterways
Watershed Boundary
County
Floyds Fork Watershed: USGS WQ Calibration, TN
Maps produced by M.Akasapu, 11-8-2011
NAD_1983_UTM_Zone_17N
Kilometers
Miles
TETRA TECH
EPA
United States
Environmental Protection
Agency
Region4 serving the southeast


Oldham
Henry
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Bullitt
Salt River
Floyds Fork
Cedar Creek
Pennsylvania Run
Chenoweth Run
Harrods Creek
USGS ID: 03297830
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USGS ID: 03298000
USGS ID: 03298005
USGS ID: 03298020
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USGS ID: 03298200
USGS ID: 03298250
N
Legend
Water Quality Calibration
TP Score
VG (< 40)
G (41-90)
F (91-150)
P (151-225)
Waterways
Watershed Boundary
County
Floyds Fork Watershed: USGS WQ Calibration, TP
Maps produced by M.Akasapu, 11-8-2011
NAD_1983_UTM_Zone_17N
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Miles
TETRA TECH
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United States
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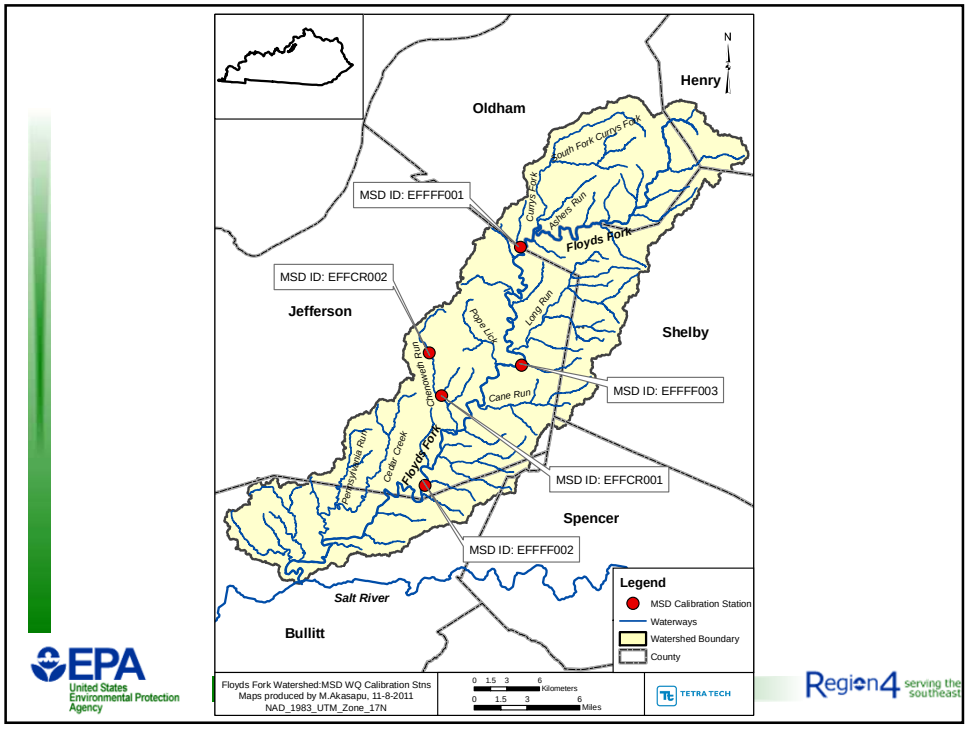
Henry
Oldham
Jefferson
Shelby
Spencer
Bullitt
Salt River
Floyds Fork
South Fork Currys Fork
Currys Fork
Ashers Run
Long Run
Pope Lick
Cane Run
Chenoweth Run
Cedar Creek
Pennsylvania Run
MSD ID: EFFFF001
MSD ID: EFFCR002
MSD ID: EFFFF003
MSD ID: EFFCR001
MSD ID: EFFFF002
Legend
MSD Calibration Station
Waterways
Watershed Boundary
County
Floyds Fork Watershed:MSD WQ Calibration Stns
Maps produced by M.Akasapu, 11-8-2011
NAD_1983_UTM_Zone_17N
Kilometers
Miles
TETRA TECH
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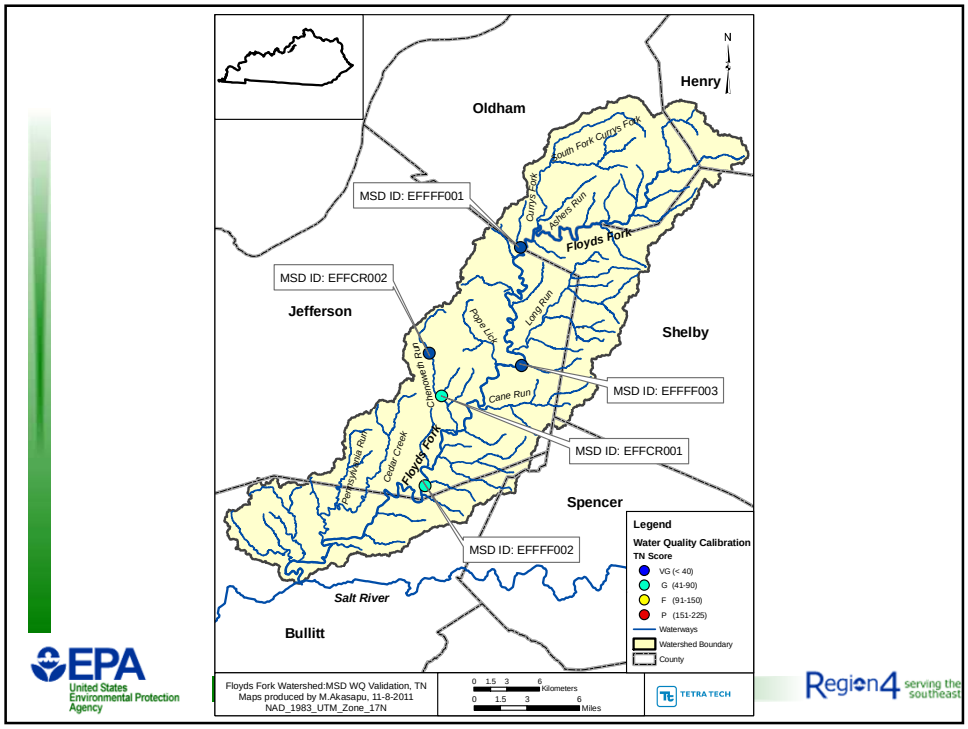
Henry
Oldham
Jefferson
Shelby
Spencer
Bullitt
Salt River
Floyds Fork
South Fork Currys Fork
Currys Fork
Ashers Run
Long Run
Pope Lick
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Cedar Creek
Pennsylvania Run
MSD ID: EFFFF001
MSD ID: EFFCR002
MSD ID: EFFFF003
MSD ID: EFFCR001
MSD ID: EFFFF002
Legend
Water Quality Calibration
TN Score
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G (41-90)
F (91-150)
P (151-225)
Waterways
Watershed Boundary
County
Floyds Fork Watershed:MSD WQ Validation, TN
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NAD_1983_UTM_Zone_17N
Kilometers
Miles
TETRA TECH
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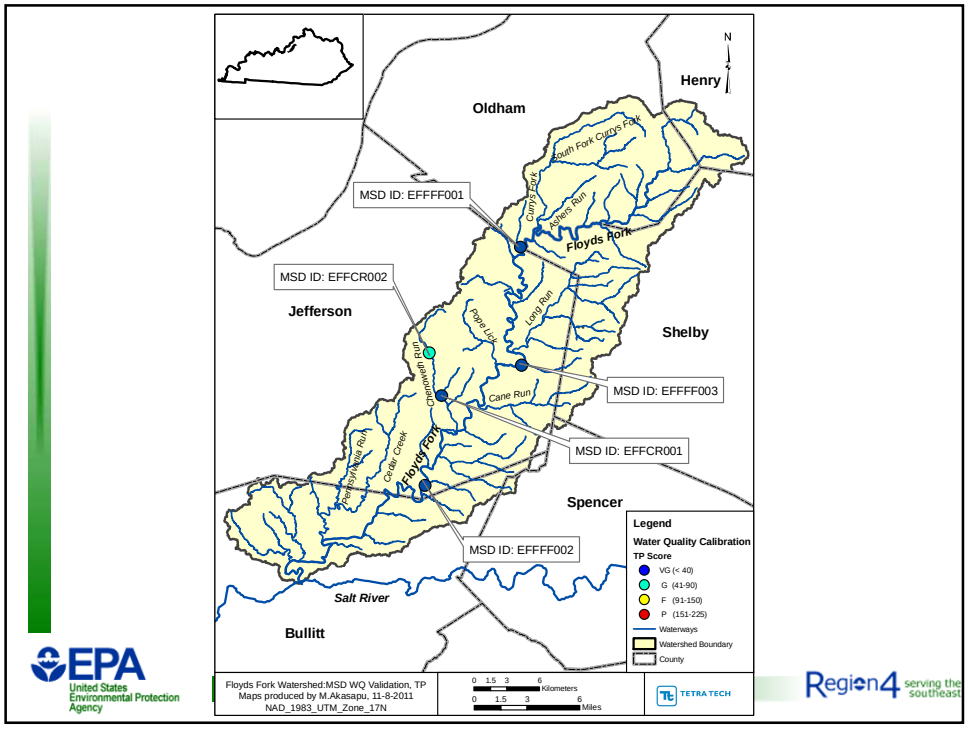
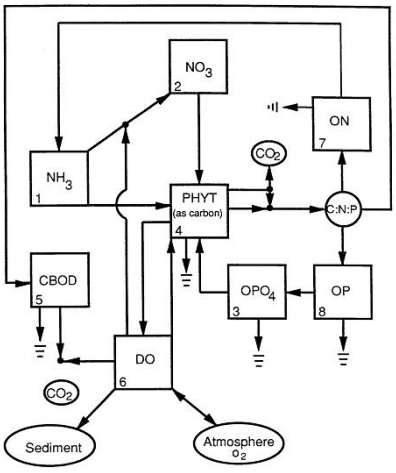


Water Quality Model

- Water Quality Analysis Simulation Program (WASP)
- Dynamic
- Full Eutrophication Kinetics
- Parameters simulated
  - DO
  - BOD
  - Ammonia
  - Nitrate-Nitrite
  - Organic Nitrogen
  - Organic Phosphorus
  - Ortho Phosphorus
  - Chlorophyll a
  - pH



Linkage to Water Quality Model

- Calibrate LSPC Watershed Model
- Removed Point Sources, SSO's and Water Withdrawals from the watershed model
- Run watershed model to get Land Use only outputs
- Use WRDB to process LSPC outputs into WASP inputs
- Processed Point Sources, SSO's and Water Withdrawals to be input into WASP
- Create WASP input file
- Began Calibrating WASP model

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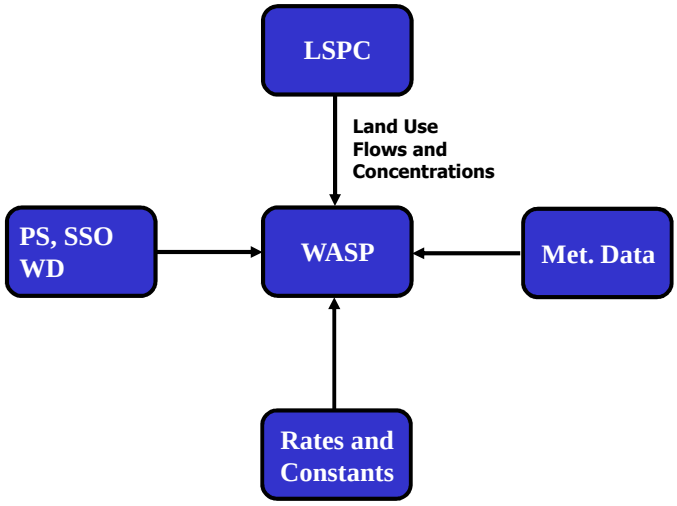
Linkage to Water Quality Model



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WASP Segmentation

- Floyds Fork and its tributaries were divided into a series of computational segments.
- A BASINS/WASP plug-in user interface was used to carry out the segmentation. Used NHDPlus flowlines.
- A maximum and minimum travel time was specified to divide the waterbody into segments of desirable length.
- Few segments were also aggregated or divided based on the location of the point sources, flow and water quality stations.
- Segments that were not included in the NHDPlus flowline coverage but included in the LSPC watershed model were added manually.

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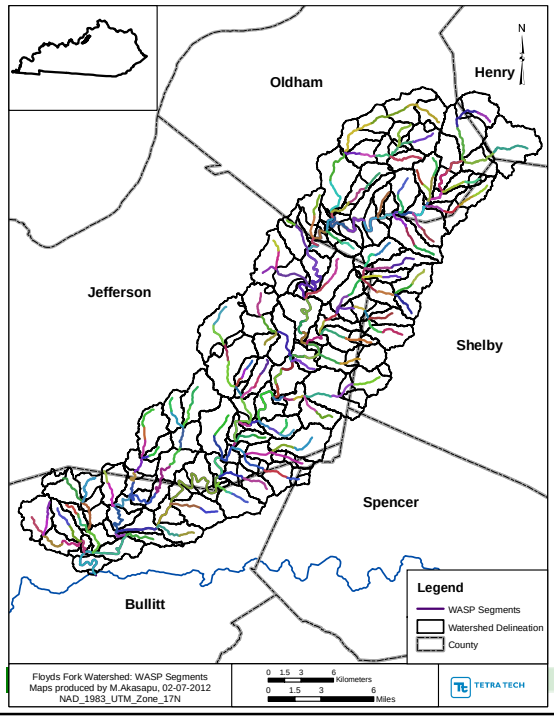

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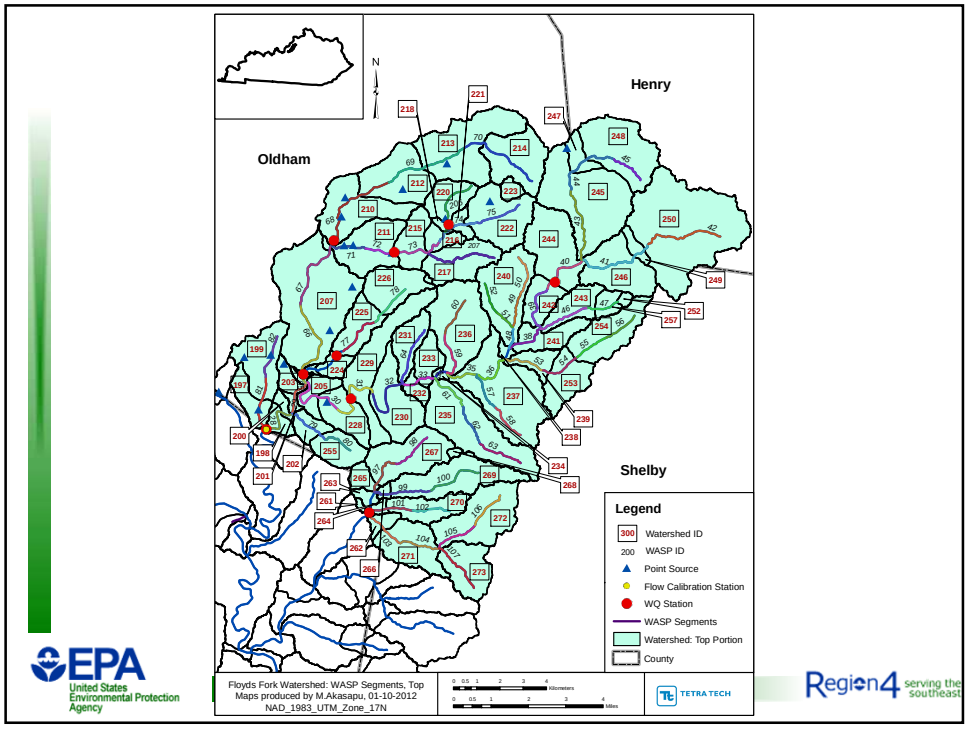
Henry
Oldham
Shelby
Legend
Watershed ID
WASP ID
Point Source
Flow Calibration Station
WQ Station
WASP Segments
Watershed: Top Portion
County
Floyds Fork Watershed: WASP Segments, Top
Maps produced by M.Akasapu, 01-10-2012
NAD_1983_UTM_Zone_17N
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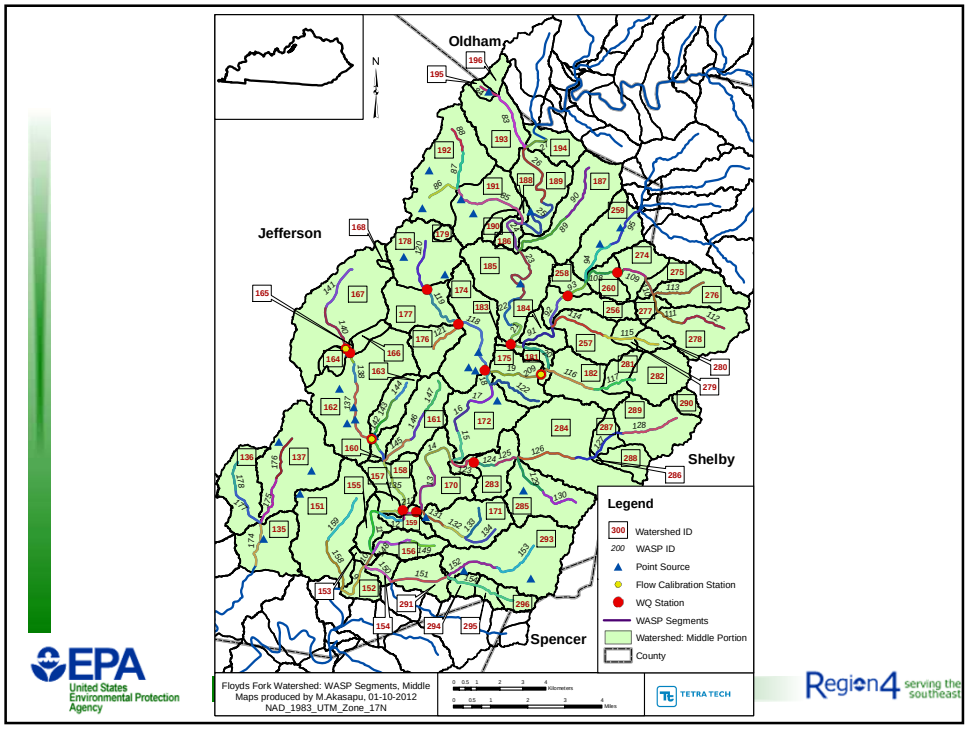
Oldham
Jefferson
Shelby
Spencer
Legend
Watershed ID
WASP ID
Point Source
Flow Calibration Station
WQ Station
WASP Segments
Watershed: Middle Portion
County
Floyds Fork Watershed: WASP Segments, Middle
Maps produced by M.Akasapu, 01-10-2012
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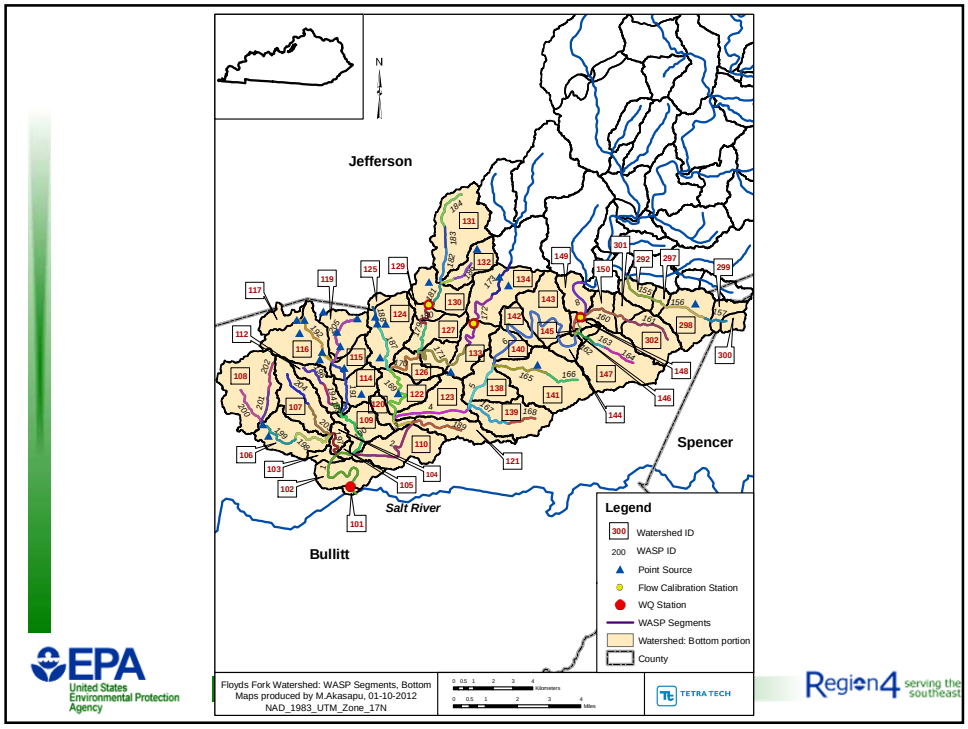

Boundary Conditions

- LSPC Flows and Concentrations (Land Use only)
  - Instream
  - Overland
- Water Temperature Functions
- Meteorological Data
  - Wind
  - Solar Radiation
  - Light
- Point Source Dischargers
- Water Withdrawals
- SSOs

- Fraction of Daylight

→ Same inputs as watershed

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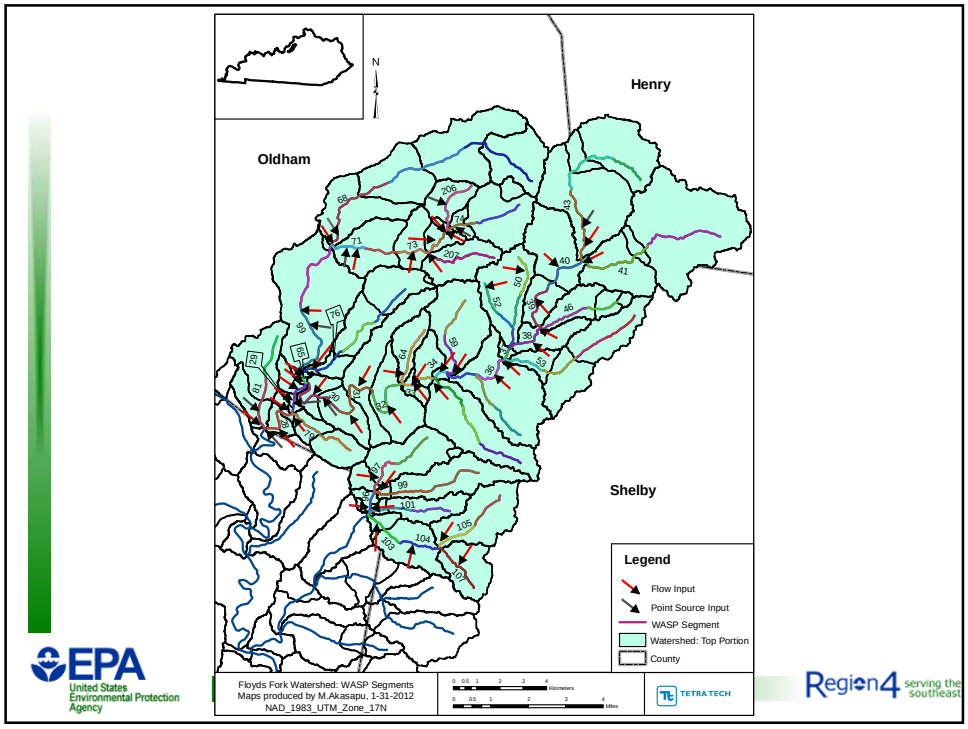
Henry
Oldham
Shelby
Legend
Flow Input
Point Source Input
WASP Segment
Watershed: Top Portion
County
Floyds Fork Watershed: WASP Segments
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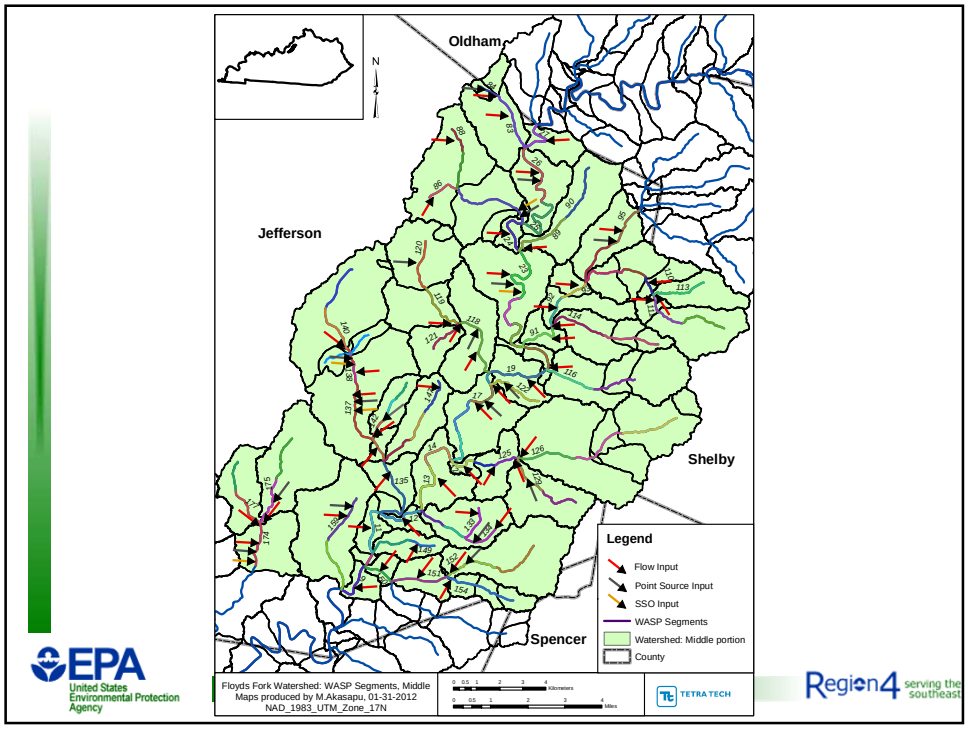
Oldham
Jefferson
Shelby
Spencer
Legend
Flow Input
Point Source Input
SSO Input
WASP Segments
Watershed: Middle portion
County
Floyds Fork Watershed: WASP Segments, Middle
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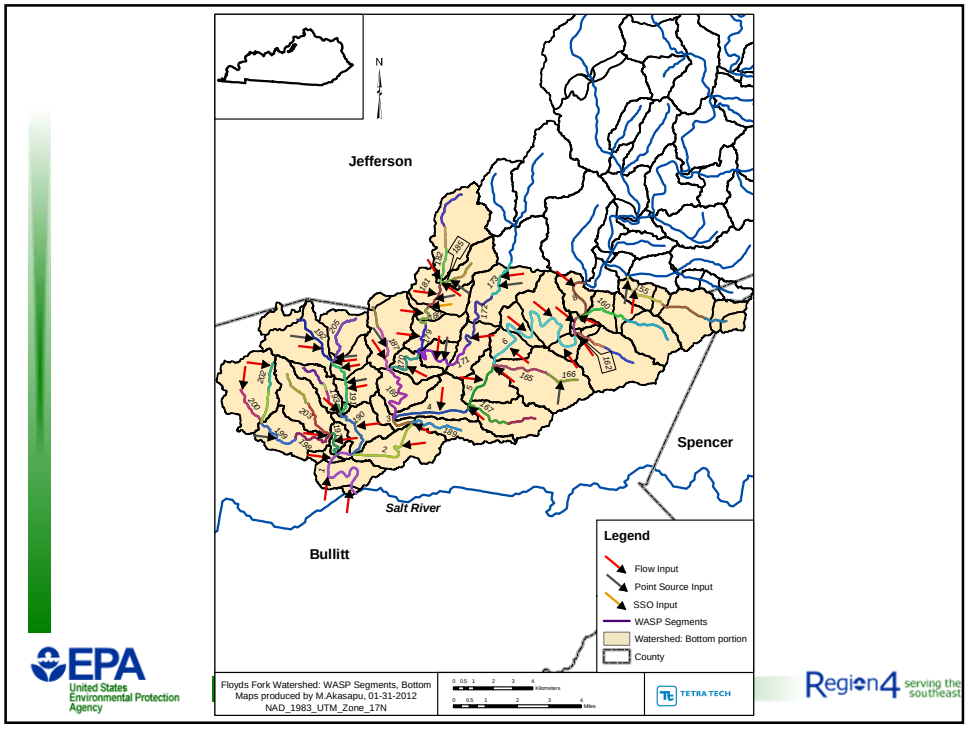
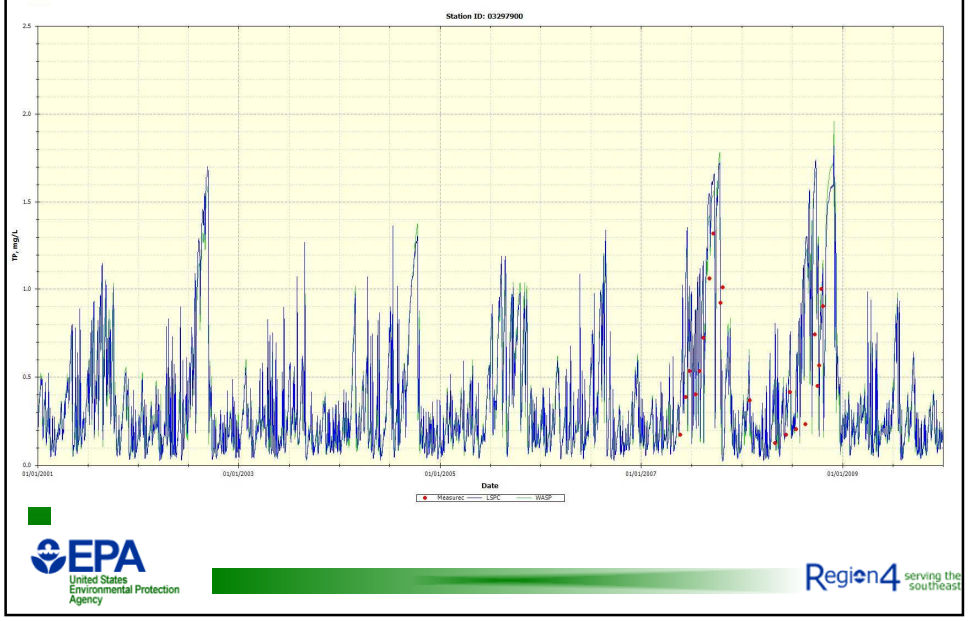


LSPC output vs. WASP output



LSPC vs. WASP
Hydrology Calibration – Qualitative

Station	Station Name	WASP Qualitative score	LSPC Qualitative score
Location : Main Stem, Floyds Fork			
03297900	Floyds Fork near Peewee Valley	G	VG
03298000	Floyds Fork at Fisherville	VG	VG
03298200	Floyds Fork near Mt. Washington	VG	VG
Location: Tributaries			
03298135	Chenoweth Run at Ruckriegal Parkway	G	G
03298150	Chenoweth Run at Gelhaus Lane	G	VG
03298250	Cedar Creek at Thixton Road	G	G
03298300	Pennsylvania Run at Mt. Washington	G	VG

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LSPC vs. WASP
Water Quality Calibration – Qualitative (TN)

Station	Station Name	WASP Qualitative score	LSPC Qualitative score
Location: Main Stem, Floyds Fork			
03297830	Floyds Fork at Highway 53	VG	VG
03297845	Floyds Fork near Crestwood	VG	G
03297900	Floyds Fork near Peewee Valley	VG	G
03297930	Floyds Fork at Echo trail bridge	G	G
03298000	Floyds Fork at Fisherville	VG	G
03298120	Floyds Fork at Seatonville Road	VG	G
03298200	Floyds Fork near Mt. Washington	VG	G
03298470	Floyds Fork near Shepherdsville	VG	G
Location: Tributaries			
03297850	South Fork Curry's Fork at Moody Lane	G	VG
03297855	South Fork Curry's Fork at Highway 393	VG	VG
03297860	North Fork Curry's Fork at Stone Ridge road	G	G
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03297975	South Long Run at Hobbs Lane	VG	VG
03297980	Long Run near Fisherville	VG	VG
03298005	Pope lick at South poope lick road near Fisherville	VG	VG
03298020	Cane Run at Thurman Road	VG	VG
03298100	Pope lick at pope lick road near Middletown	VG	G
03298110	Pope lick at Rehl road near Fisherville	VG	VG
03298135	Chenoweth Run at Ruckriegal Parkway	G	G
03298138	Chenoweth Run at Jeffersontown STP at Jeffersontown	G	G
03298150	Chenoweth Run at Gelhaus Lane near Fern creek	G	G
03298160	Chenoweth Run at Seatonville road near Jeffersontown	G	G
03298250	Cedar Creek at Thixton Road	VG	VG
03298300	Pennsylvania Run at Mt. Washington	G	G

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LSPC vs. WASP
Water Quality Calibration – Qualitative (TP)

Station	Station Name	WASP Qualitative score	LSPC Qualitative score
Location: Main Stem, Floyds Fork			
03297830	Floyds Fork at Highway 53	VG	VG
03297845	Floyds Fork near Crestwood	G	G
03297900	Floyds Fork near Peewee Valley	G	G
03297930	Floyds Fork at Echo trail bridge	G	G
03298000	Floyds Fork at Fisherville	VG	VG
03298120	Floyds Fork at Seatonville Road	G	VG
03298200	Floyds Fork near Mt. Washington	VG	G
03298470	Floyds Fork near Shepherdsville	VG	VG
Location: Tributaries			
03297850	South Fork Curry's Fork at Moody Lane	G	G
03297855	South Fork Curry's Fork at Highway 393	G	G
03297860	North Fork Curry's Fork at Stone Ridge road	G	G
03297875	Ashers Run at Abbott lane near Crestwood	VG	G
03297880	Currys Fork near Crestwood	VG	VG
03297950	Long Run at Old stage coach road	VG	VG
03297975	South Long Run at Hobbs Lane	G	G
03297980	Long Run near Fisherville	G	G
03298005	Pope lick at South poope lick road near Fisherville	G	G
03298020	Cane Run at Thurman Road	VG	VG
03298100	Pope lick at pope lick road near Middletown	G	VG
03298110	Pope lick at Rehl road near Fisherville	VG	VG
03298135	Chenoweth Run at Ruckriegal Parkway	VG	VG
03298138	Chenoweth Run at Jeffersontown STP at Jeffersontown	G	G
03298150	Chenoweth Run at Gelhaus Lane near Fern creek	VG	VG
03298160	Chenoweth Run at Seatonville road near Jeffersontown	VG	VG
03298250	Cedar Creek at Thixton Road	VG	VG
03298300	Pennsylvania Run at Mt. Washington	G	G

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Water Quality Calibration

- Calibration period
  - January 1, 2001 through December 31, 2010
- 26 USGS Stations
  - Primary period of data – 2007 and 2008
  - 8 Main Stem
  - 18 Tributaries
- 5 MSD
  - 3 Main Stem
  - 2 Tributaries (Lower Chenoweth Run)
- Quantitative Calibration
- Qualitative Calibration
- Focusing on Nutrient Species and Chlorophyll-a

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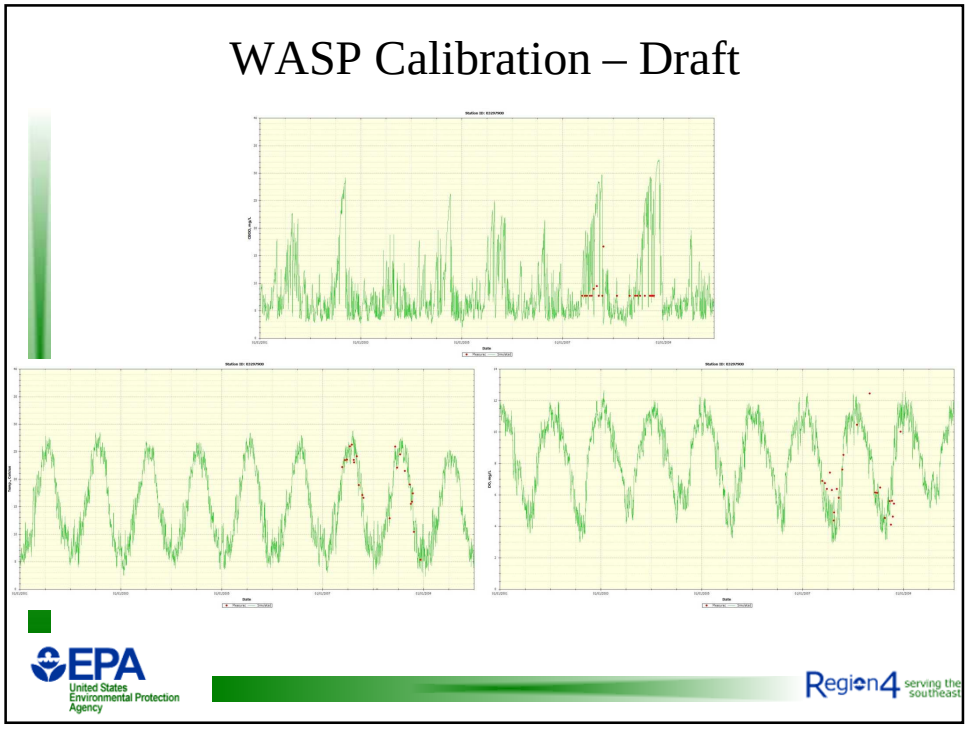
WASP Calibration – Draft
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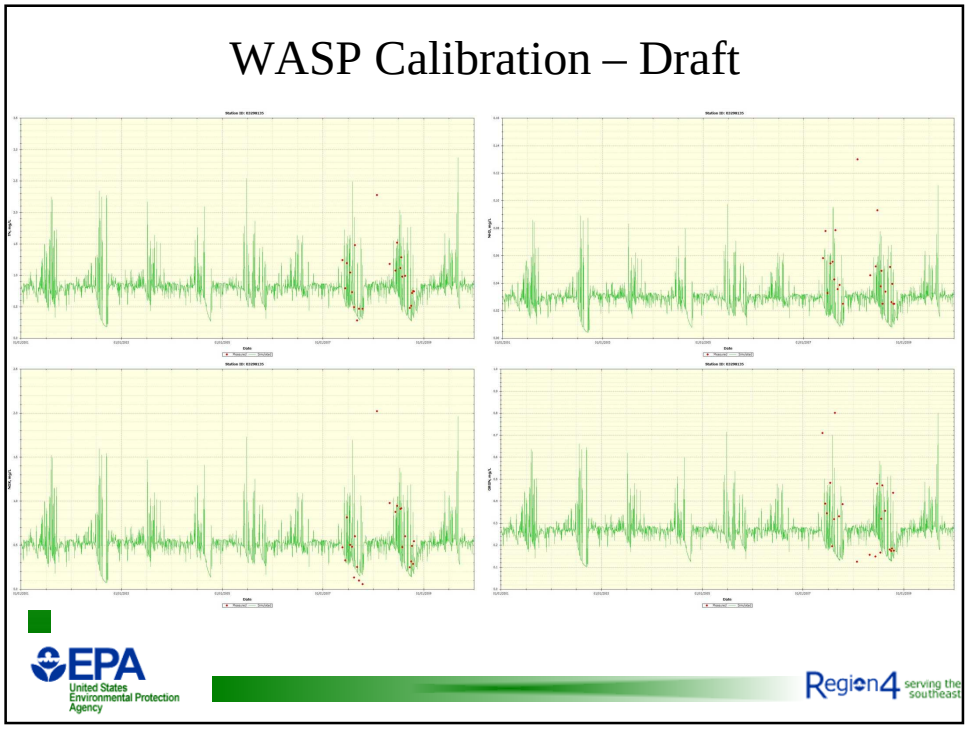
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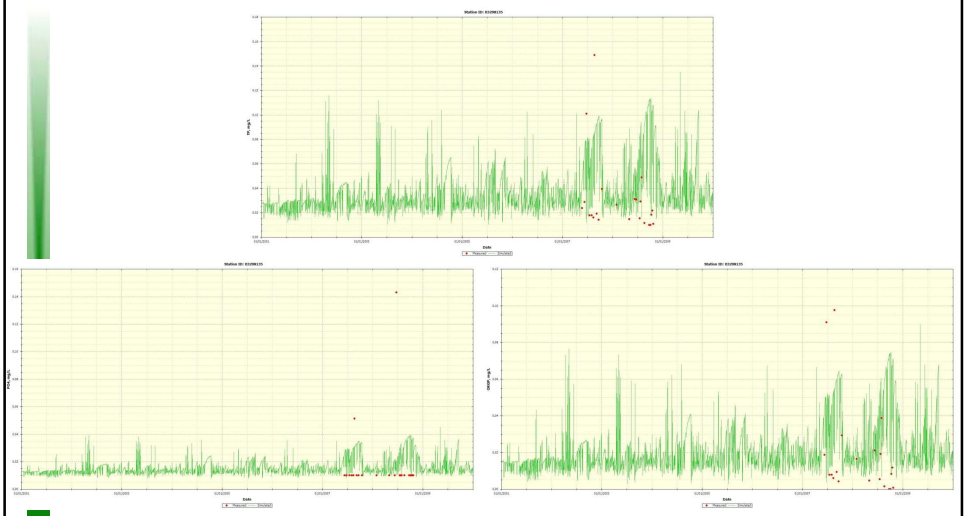
WASP Calibration – Draft



WASP Calibration – Draft

Station	Station Name	Nitrogen				Phosphorus		
		TN	NH3	NOX	ORGN	TP	PO4	ORGP
Location : Main Stem, Floyds Fork								
03297830	Floyds Fork at Highway 53	VG	VG	VG	G	VG	VG	VG
03297845	Floyds Fork near Crestwood	VG	VG	VG	G	G	G	G
03297900	Floyds Fork near Peewee Valley	VG	VG	VG	G	G	VG	G
03297930	Floyds Fork at Echo trail bridge	G	VG	G	G	G	VG	G
03298000	Floyds Fork at Fisherville	VG	G	G	VG	VG	VG	VG
03298120	Floyds Fork at Seatonville Road	VG	G	VG	G	G	VG	G
03298200	Floyds Fork near Mt. Washington	VG	F	G	VG	VG	G	G
03298470	Floyds Fork near Shepherdsville	VG	P	VG	VG	VG	VG	VG
Location : Tributaries								
03297850	South Fork Curry's Fork at Moody Lane	G	G	G	VG	G	G	G
03297855	South Fork Curry's Fork at Highway 393	VG	G	G	VG	G	G	VG
03297860	North Fork Curry's Fork at Stone Ridge road	G	VG	G	VG	G	G	G
03297875	Ashers Run at Abbott lane near Crestwood	VG	VG	VG	G	VG	VG	VG
03297880	Currys Fork near Crestwood	VG	VG	VG	VG	VG	G	G
03297950	Long Run at Old stage coach road	G	VG	F	VG	VG	VG	VG
03297975	South Long Run at Hobbs Lane	VG	VG	G	VG	G	G	G
03297980	Long Run near Fisherville	VG	VG	VG	G	G	G	G
03298005	Pope lick at South poope lick road near Fisherville	VG	VG	VG	VG	G	F	G
03298020	Cane Run at Thurman Road	VG	G	G	VG	VG	VG	VG
03298100	Pope lick at pope lick road near Middletown	VG	G	VG	VG	G	G	G
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03298135	Chenoweth Run at Ruckriegal Parkway	G	G	G	G	VG	VG	VG
03298138	Chenoweth Run at Jeffersontown STP at Jeffersontown	G	G	G	VG	G	G	G
03298150	Chenoweth Run at Gelhaus Lane near Fern creek	G	VG	G	VG	VG	VG	VG
03298160	Chenoweth Run at Seatonville road near Jeffersontown	G	P	G	G	VG	G	F
03298250	Cedar Creek at Thixton Road	VG	VG	VG	G	VG	G	F
03298300	Pennsylvania Run at Mt. Washington	G	VG	G	G	G	VG	VG

Next Steps

- Continue calibrating instream water quality model
  - Minor updates to flow calibration
  - Update water quality assumptions for point sources
  - Focus on nutrients species
  - Chlorophyll-a calibration
- Evaluate any new data sources
- Begin running scenarios
- Begin evaluating water quality targets

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Questions?

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